Special Lecture on "Piezoelectric Energy Harvesting"

Speaker: Neelam Roy, Assistant Professor in Physics, Mathabhanga College

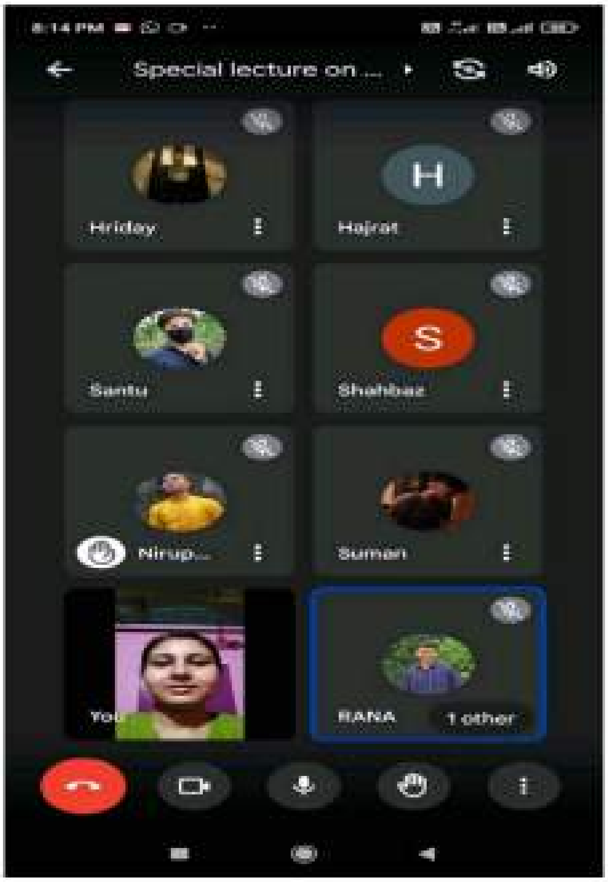
Dated: 5th April 2022

Place: Department of Physics

A special lecture on "Piezoelectric Energy Harvesting" is organized by Department of Physics, Mathabhanga College on 5th April 2022. The lecture is delivered by Neelam Roy, Assistant Professor, Department of Physics, Mathabhanga College. The programme was inaugurated by Dr. Sulagna Dutta, Teache-In-Charge, Mathabhanga College. After inaugural ceremony speaker delivered an interactive presentation in front of the audience. Students from Physics department, teachers of Physics Department and some teachers from other departments participated in the special lecture. The lecture covered a wide area of piezoelectric energy harvesting. The role of piezoelectric materials in energy harvesting is discussed in this lecture. Discussion on the development of low-power electronic devices such as microelectronics and wireless sensor nodes, piezoelectric materials is included in the lecture. Further the procedure of obtaining the electric energy from the surrounding environment by converting the vibrations into electrical energy by using piezoelectric materials is discussed. The students and other participants are benefited by this lecture

Special Lecture on "Satellite Communication"
Speaker: Neelam Roy, Assistant Professor in Physics, Mathabhanga College
Dated: 5th December 2021
Mode of lecture: Online (Google Meet)
Link: https://meet.google.com/kjt-jaqb-poe

A special lecture on "Satellite Communication" in virtual mode is organized by Department of Physics, Mathabhanga College on 6th December 2021. The lecture is delivered by Neelam Roy, Assistant Professor, Department of Physics, Mathabhanga College. Dr. Sulagna Dutta, Teache-In-Charge of the college delivered an introductory lecture highlighting the importance of special lecture. After the inaugural lecture speaker delivered an interactive lecture on "Satellite Communication". Total 8(eight) students are benefited by this lecture.



Screen shot of the lecture

Mathabhanga College , Coochbehar

Department of physics

Report on special lecture

On

Liquid drop model

By

Mr Eya Hannan

10/07/2021 , 12pm to 2pm

Report on special lecture on

Liquid drop model

By

Mr Eya Hannan

Academic year: 2020-2021

Date: 10/07/2021

Time: 12pm to 2pm

Details of the faculty

Name: Eya Hannan

Designation: SACT

Institution: Mathabhanga College

Qualification: M.Sc

Specialization: Nuclear Physics

Contact Number: 9064355815

Email Id: eyahannan04@gmail.com

Introduction

The lecture session began with a speech by Dr Sulagna Dutta , H.O.D. , Physics Dept, Mathabhanga College. After that Mr Eya Hannan started his lecture with an introduction to this topic and he explained the topic very briefly and very clearly.

Outline of the Lecture

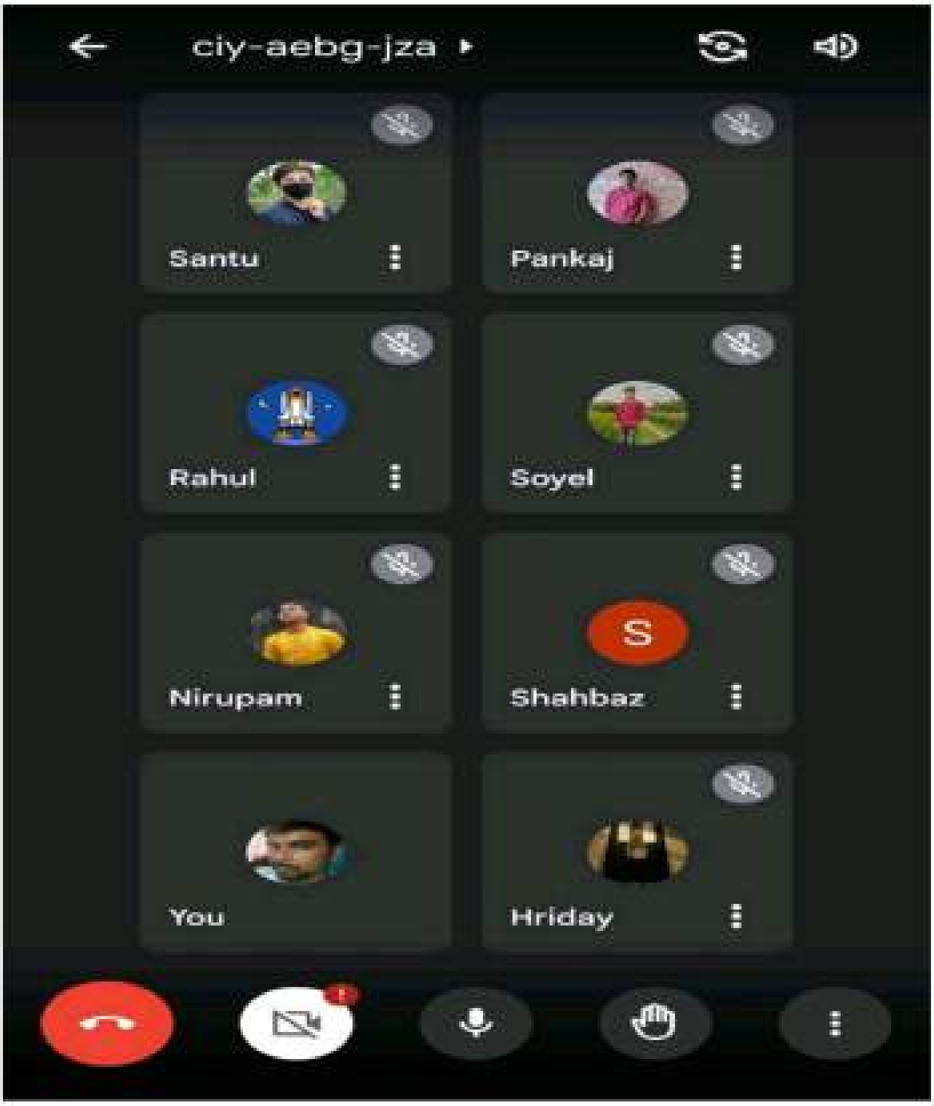
The aim is to explain nuclei's masses and binding energies. The Liquid Drop Model is named after the fact that nuclei are thought to behave similarly to liquids (at least to first order). A liquid's molecules are kept together by the Van der Waals force, which exists only between close neighbours.

The liquid drop model of the nucleus explains forces in atomic nuclei as if they were created by a tiny liquid drop in nuclear physics. On a nuclear scale, however, the fluid is made up of nucleons (protons and neutrons). The liquid drop model accounts for the fact that the forces acting on nucleons on the surface vary from those acting on nucleons on the inside, where they are absolutely surrounded by attracting nucleons. This is analogous to considering surface tension as a factor in calculating the energy of a tiny liquid drop

Conclusion

After the completion of the lecture, there was an interactive session, where students asked their doubts. The special lecture was interesting and informative. The lecture concluded with a vote of thanks by the students and the other faculty members.

Attendance of the students:



Gravity As We Know Today

Seminar organised by Dept. of Physics
in collaboration with IQAC, Mathabhanga College

Academic year:
2020-21

Date and time:
Sep 14, 2020 at 1:30 pm

Speaker:
Dr. Rashidul Islam
Assistant Professor
Department of Physics
Mathabhanga College

Introduction

The programme was initiated by Dr. Amit Kundu, the *Teacher-in-Charge* (TIC), Mathabhanga College, through a brief address to the students. Thereafter, Prof. Aparna Biswas, the IQAC Coordinator, Mathabhanga College addressed the students.

After the introductory session, Dr. Rashidul Islam delivered his lecture in a way suitable for the undergraduates of the college, but with enough details that will stimulate their curiosity. Dr. Sulagna Dutta, the Head of the Department of Physics chaired the session. She ably coordinated the Question & Answer session between the speaker and the students filling in with her own inputs that helped the students grasp the nuances of the topic that was somewhat beyond their current level of understanding.

For the use of students and teachers alike, we attach the slides of Dr. Islam with this report.

The Big Event & Flaw in Public Perception

- **Feb 11, 2016 :** Scientists from the *Laser Interferometer Gravitational Wave Observatory (LIGO)* announced the detection gravitational waves produced by the merger of two black holes more than a billion light years from Earth. The discovery was awarded by the *2017 Nobel Prize in Physics*.
- LIGO's achievement rightly captured the public's imagination, and since that day the science of gravitational wave astronomy has remained in the news.
- Each press release or media report has been accompanied by a formulaic nod:

Gravitational waves were first predicted by Albert Einstein a century ago on the basis of his general theory of relativity.

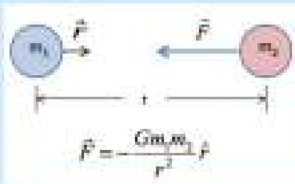
- *Alas!!! That sound-bite erases essentially the entire historical context.*

The Right Historical Context

- As a student of physics, we shall explore the the veracity of public perception and the actual truth behind the scienctific achievement.
- *Contrary to conventional wisdom, Einstein was not the only physicist attempting to create a modern description of the gravitational field.*
- Like most scientific concepts, that of gravitational waves emerged over many years, through the work of numerous architects, seeking to solve a long-recognized problem.
- With hindsight, we can say that virtually any field theory of gravity will predict gravitational waves, so long as it obeys the fundamental precept that such disturbances must propagate at finite velocity.

To begin at the beginning: Action at a distance

- When in **1687, Isaac Newton** introduced his law of gravity, it described in a single equation the gravitational attraction between any two objects.
- The striking thing was, whereas most previously known forces arose when two objects pushed or pulled each other via physical contact, Newton's gravitational force evidently operated across great voids of empty space.



- Such "action at a distance" disturbed fellow philosophers, who demanded to know how gravity was transmitted from the Earth to the Moon.
- From a modern perspective, the more disturbing aspect of Newton's law is that it assumes the gravitational force is transmitted instantaneously.
- *If the Moon suddenly disappears, lunar tides would vanish with no delay.*

Enter the concept of field

- Over next 2 centuries, such concerns gave rise to the notion of a space-filling field, which can be imagined as the medium that transmits the message.
- *A field is a continuous and continuously varying plane of action through which disturbances propagate; thus there exists no "action at a distance."*
- Now no one doubts the reality of fields; anyone who has sprinkled iron filings on a piece of paper above a bar magnet has perceived a field pretty directly.
- But back then, the existence of fields was less obvious.
- By the 1840s, however, the creators of hydrodynamics were treating fluid properties – velocity, density, pressure – as fields.
- Hydrodynamic concepts, in turn, provided the basis for the 19th century's most celebrated field theory, the electromagnetism of James Clerk Maxwell.

Through the window of the electromagnetic field

- By treating electricity and magnetism as fields, Maxwell not only showed that the two were intimately connected, but also demonstrated that electromagnetic fields can propagate as waves at the velocity of light.
- The conclusion was inescapable: Light itself was an electromagnetic wave.
- The implications of this for the understanding of gravity were not lost on Maxwell. In his 1865 *The Dynamical Theory of the Electromagnetic Field* – the very paper in which he deduced that electromagnetic waves travel at light speed – he wrote: `After tracing to the action of the surrounding medium both the magnetic and the electric attractions and repulsions [oscillations]...we are naturally led to inquire whether the attraction of gravitation, which follows the same law of the distance, is not also traceable to the action of a surrounding medium.`

The first attempt

- In other words, he wondered, can one think of gravity being propagated by a field?
- Maxwell's cue was taken up in **1893** by the English physicist **Oliver Heaviside**.
- *Writing in* **The Electrician***, the leading electrical journal of the time, Heaviside set down the gravitational analogue of Maxwell's equations and showed that they produce waves traveling at a finite velocity.*
- He found that the changes in the field would produce small perturbations in the orbital motion of the Sun.
- The nondetection of such perturbations set an upper limit on the speed of gravity, suggesting it is probably the same as the speed of light.
- Heaviside's calculations predated even special relativity and so could not give precisely correct answers, but within that restriction they are eminently sound.

Not Heaviside alone

- The idea that gravity might be propagated at a finite velocity was hardly novel; the French mathematician **Pierre-Simon Laplace** hypothesized earlier in **1770s**.
- Nor was Heaviside alone in his attempts to exploit gravity's speed limit.
- In **1901**, **Jonathan Zenneck** wrote an article on gravitation for a German encyclopedia. In it, he surveyed multiple proposals to modify Newtonian gravity to make it more closely resemble Maxwellian electromagnetism.
- In some proposals Zenneck tried to explain **Mercury's perihelion shift**: `The longitude of the planet's closest approach to the Sun kept advancing by the small angle of 43" of arc per century, and no known Newtonian forces could account for it.`
- One modified theory of gravity, by German physicist **Paul Gerber**, astoundingly gave the correct answer for Mercury's movements.

Special Relativity Debuts

- However, none of the schemes mentioned in the encyclopedia article – including Gerber's – resembled a modern relativistic theory of gravity.
- A forlorn Zenneck lamented, `All attempts to connect gravitation with other phenomena in a satisfying way are to be regarded as unsuccessful or as yet not adequately established.`
- With the **special theory of relativity** in **1905**, **Einstein** completed Maxwell's unification of electricity and magnetism by showing the two fields to be really one.
- Special relativity was founded on two immortal postulates.
  - First, that *experimenters must always get the same result for any experiment in any frame of reference (that is, no matter how fast they are moving relative to each other), as long as they are moving at constant velocity.*
  - Second, that *observers will always measure the speed of light to have the same value, 300,000 kilometers per second, regardless of their motion.*

Special Relativity Debuts

- These postulates led to the conclusion that no information – not even the propagation of gravity – can travel faster than light, and they demanded a thorough modification of Newtonian physics.
- During the same time, the French polymath **Henri Poincaré** was independently publishing his own researches along similar lines.
- *On the Dynamics of the Electron,* Poincaré's 1905 paper, contains much the same mathematical content as Einstein's, but he failed to ground his ideas on the two key postulates, which is why Einstein receives the credit for relativity.
- The last section of Poincaré's paper is titled *Hypothesis on Gravitation.*
- In it, Poincaré attempted to understand how Newtonian gravity between moving bodies should be modified by the **Lorentz transformations**, which describe how the electromagnetic field changes to observers moving at different velocities.

Limitation of Special Relativity $\Longrightarrow$ Acceleration and Equivalence

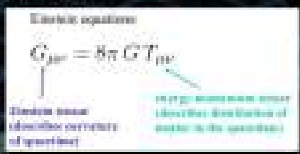
- Much as Heaviside had done (but this time in the context of a relativistically correct framework), Poincaré assumed that the gravitational force propagates at the speed of light; therefore, there will be a time lag – called a retardation by physicists – between any change in gravity and the effect.
- Such changes, Poincaré explicitly stated, are propagated by gravitational waves, although he does not elaborate on their form.
- Poincaré was more correct in his assumptions than he perhaps realized: Retardation is the only thing a field theory needs to produce gravitational waves.
- Soon, Einstein understood that gravitation could not be consistently incorporated into his special theory of relativity. *The reason: the principle of equivalence.*
- In **1907**, he realized that there is no experimental way to distinguish an acceleration due to motion from an acceleration due to a gravitational field.

Acceleration and Equivalence $\Longrightarrow$ A new theory of Gravity

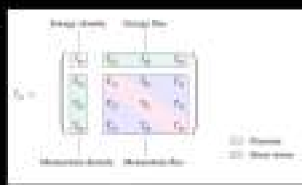
- In the classic example, a rider in an elevator cannot tell whether the elevator is sitting still on Earth or accelerating at a rate of 9.8 meters per second squared (that is, 1g) in outer space. The two effects are exactly equivalent.
- Put another way, all masses, regardless of their nature or composition, fall at the same rate in a gravitational field.
- Special relativity deals only with bodies moving at constant velocity, not accelerating ones. The principle of equivalence showed Einstein that special relativity therefore could not be extended to explain gravity.
- Conversely, *a theory that could explain accelerating objects would necessarily give Einstein a new theory of gravity as well.*

A new theory of Gravity

- In Einstein's monumental 1916 paper announcing the completion of general relativity, one of the first things he did was to return to the problem of **Mercury's perihelion** – and he got the orbital shift exactly right.
- However, there was no mention of gravitational waves in the paper.
- In general relativity, gravity determines the fabric of spacetime, which resembles the surface of a boundless trampoline, capable of being stretched in all directions.



- Whereas Newton required one equation to describe the force of gravity, Einstein required 10 to describe the entire field. The mathematical objects required to do this are called tensors (loosely, they are matrices as opposed to vectors).

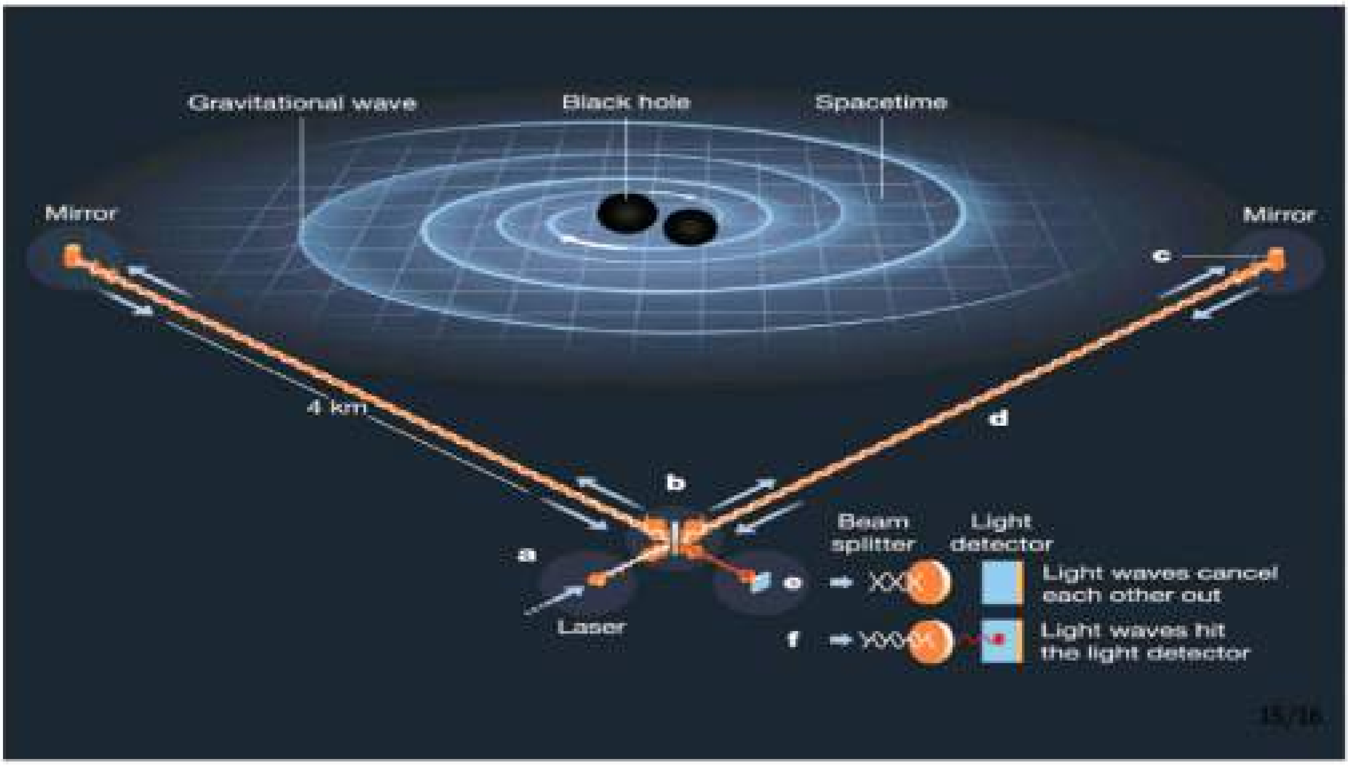


Gravitational wave

- The tensors of relativity embody the coordinates you are using to describe the problem at hand. During any analysis, it is easy to confuse what is happening according to your coordinates with what is taking place in the physical world.
- In one coordinate system, a wave may appear to be rippling across space, whereas in another coordinate system space may appear absolutely flat.
- Einstein had fallen into this trap, more or less misplacing the location of gravitational energy. In his 1918 paper, Einstein credits **Nordström** with putting him on the right track. Rectifying his error, Einstein finally arrives at the correct formula for gravitational radiation.
- Einstein's 1918 paper on gravitational waves stands as the foundation of the subject as we know it today. Yet the confusion didn't remotely end there.

Finally captured

- Not until the late **1950s** did the combined work of physicists **Hermann Bondi, Felix Pirani, Ivor Robinson, and Andrzej Trautman** finally establish the reality of gravitational waves in the full theory of general relativity.
- Even then it took another 60 years of theoretical, experimental, and instrumental progress before physicists were able to directly detect gravitational waves and explore their real-world properties.
- *The* **August 2017***, observation of near-simultaneous gravitational and gamma-ray signals from a pair of colliding neutron stars 130 million light years away proved that, as expected, gravitational waves propagate at the speed of light.*
- Also, like electromagnetic waves, they are transverse, oscillating perpendicularly to the direction of their propagation. But at a fundamental level, the two types of waves are completely different.


Gravitational wave
Black hole
Spacetime
Mirror
Mirror
c
4 km
d
b
a
Beam splitter
Light detector
Laser
e
Light waves cancel each other out
f
Light waves hit the light detector
15/16

Hubble's Exploration of the Universe

Seminar organised by Dept. of Physics
in collaboration with IQAC, Mathabhanga College

Academic year:
2021-22

Date and time:
Sep 17, 2021 at 1:30 pm

Speaker:
Dr. Rashidul Islam
Assistant Professor
Department of Physics
Mathabhanga College

Introduction

Starting the programme, Dr. Sulagna Dutta, the *Teacher-in-Charge* (TIC), Mathabhanga College, who is also a professor of the Department of Physics, delivered a brief motivational speech to the students. Prof. Aparna Biswas, the IQAC Coordiantor, Mathabhanga College poured her own thoughts in to the mix to give the students a perspective for new endavours.

Afterwards, Dr. Rashidul Islam delivered his lecture to the students to pique the curiosity of the students further. Dr. Dibakar Dutta of the Department of Physics chaired the session. He worked as a bridge for the students to fill in their understandings of the topic.

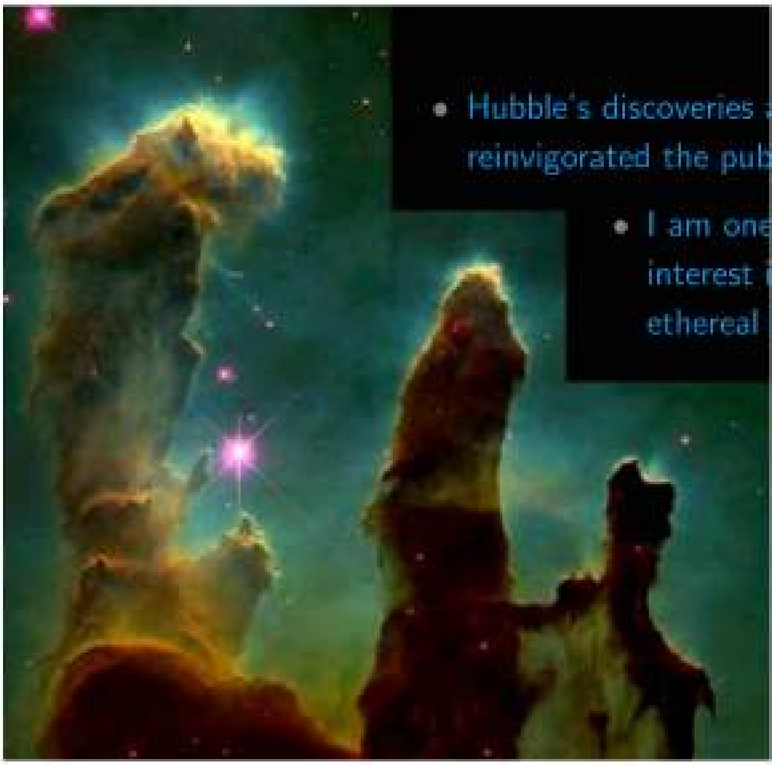
For the use of students and teachers alike, we attach the slides of Dr. Islam with this report.

The Turning Point

- In **1609**, visionary Italian scientist **Galileo Galilei** turned the newly invented optical device of his day — the telescope — to view the heavens. His observations conclusively showed that there were celestial bodies (the moons of Jupiter) that did not revolve around the Earth, launching a revolution that forever changed our view of an Earth-centered universe.
- Almost four centuries later, the launch of NASA's **Hubble Space Telescope** aboard the **Space Shuttle Discovery** in **1990** started another revolution in astronomy.

The Hubble Space Telescope

- Developed as a partnership between the United States space program and the European Space Agency, Hubble orbits 340 miles above Earth's surface.
- Its gaze outward lies beyond the distorting effects of the atmosphere, which blurs starlight and blocks some important wavelengths of light from reaching the ground.
- This vantage point allows Hubble to observe astronomical objects and phenomena more consistently and with better detail than generally attainable from ground-based observatories.
- The telescope's sensitive cameras and spectrographs can view objects as nearby and small as colliding asteroids to distant star-forming galaxies that date back to when the universe was only three percent of its current age.



- Hubble's discoveries and memorable photos have also reinvigorated the public's interest in astronomy.
  - I am one of those many enthusiasts whose interest in physics has been shaped by those ethereal images.
    - Here I am going to share some my exporations with you through this presentation.
    - So, welcome aboard.

Discovering a Runaway Universe

- Our cosmos is getting bigger. Nearly a century ago Edwin Hubble measured the expansion rate of the universe. This value, called the Hubble constant, is an essential ingredient needed to determine the age, size and fate of the cosmos.
- Before Hubble was launched, the value of the Hubble constant was imprecise, and calculations of the universe's age ranged from 10 billion to 20 billion years.
- Now, astronomers using Hubble have refined their estimates of the universe's present expansion rate and are working to make it more accurate.
- They do this by getting better galaxy distance measurements from Hubble and coupling these values with the best galaxy-velocity measurements obtained from other telescopes.

Discovering a Runaway Universe

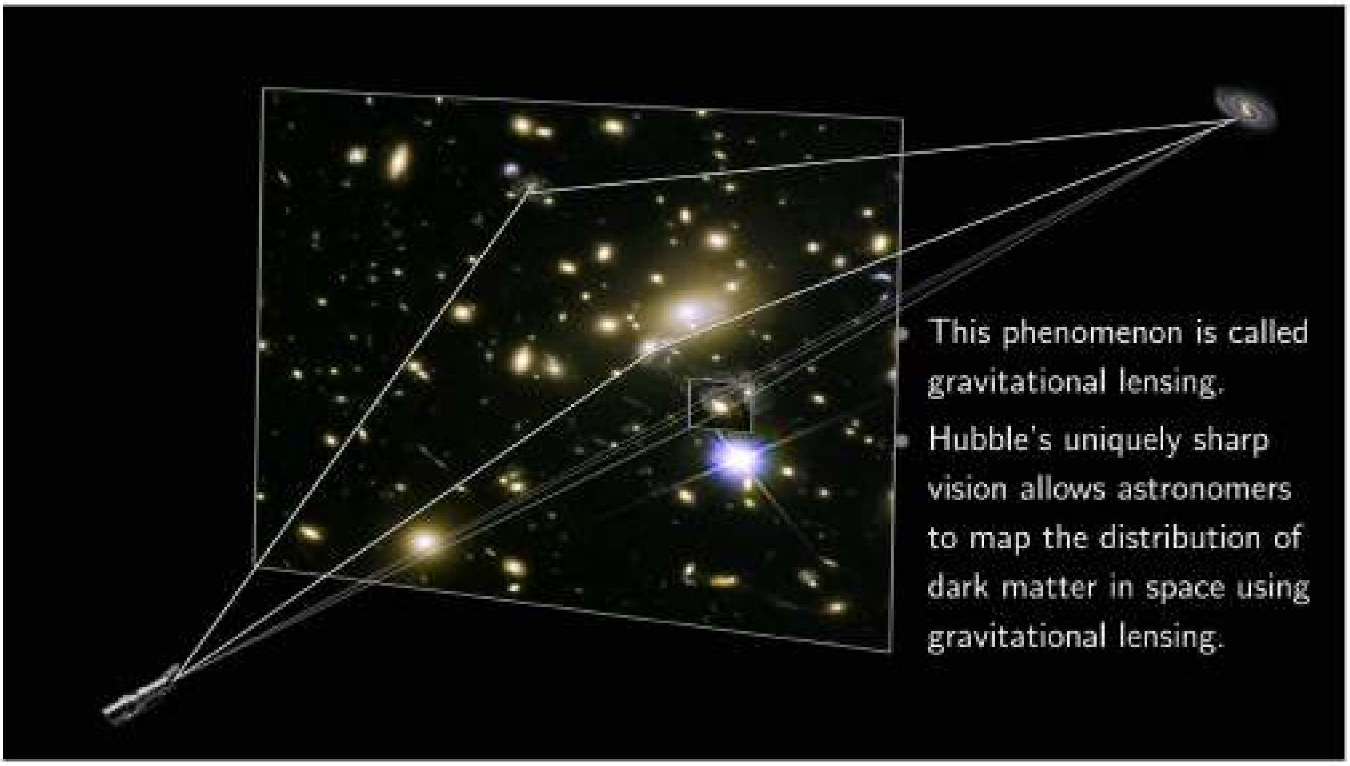
- Scientists measure distances by comparing the brightness of a known object in our galaxy (like a star or an exploded star) to that of a similar object in a distant galaxy. With Hubble's refined distance values, calculations currently put the age of the universe as 13.8 billion years.
- To the surprise of astronomers, Hubble observations along with those of ground-based observatories have also shown that the universe is not just expanding, but accelerating — a discovery that won the 2011 Nobel Prize in Physics.
- Many scientists believe this acceleration is caused by a "dark energy" that pervades the universe.
- Dark energy can be thought of as a sort of "antigravity" that is pushing galaxies apart by stretching space at an increasing pace.

Discovering a Runaway Universe

- The nature of this energy is a complete mystery, even though astronomers estimate that it makes up about 70 percent of the mass and energy in the entire universe.
- Though it cannot be measured directly using current technology, dark energy can be characterized by its effect on matter in the visible universe.
- By observing how dark energy behaves over time, astronomers hope to gain a better understanding of what it is and how it might affect the future of the cosmos.

Shining a Light on Dark Matter

- Dark matter is an invisible form of matter that makes up most of the universe's mass and creates its underlying structure.
- Dark matter's gravity drives normal matter (gas and dust) to collect and build up into stars and galaxies.
- Although astronomers cannot see dark matter, they can detect its influence by observing how the gravity of massive galaxy clusters, which contain dark matter, bends and distorts the light of more-distant galaxies located behind the cluster.



This phenomenon is called gravitational lensing.
Hubble's uniquely sharp vision allows astronomers to map the distribution of dark matter in space using gravitational lensing.

Exploring the Birth of Stars

Hubble's infrared detectors have penetrated gigantic, turbulent clouds of gas and dust where tens of thousands of stars are bursting to life.

The observations show that star birth is a violent process, producing intense ultraviolet radiation and shock fronts.

- The radiation clears out cavities in stellar nursery clouds and erodes material from giant gas pillars that are incubators for fledgling stars.

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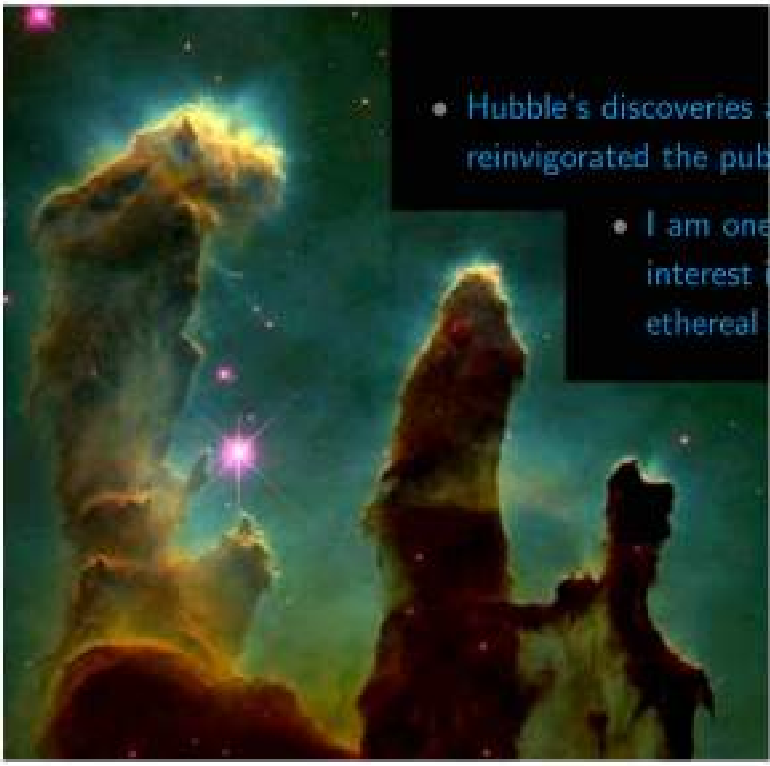

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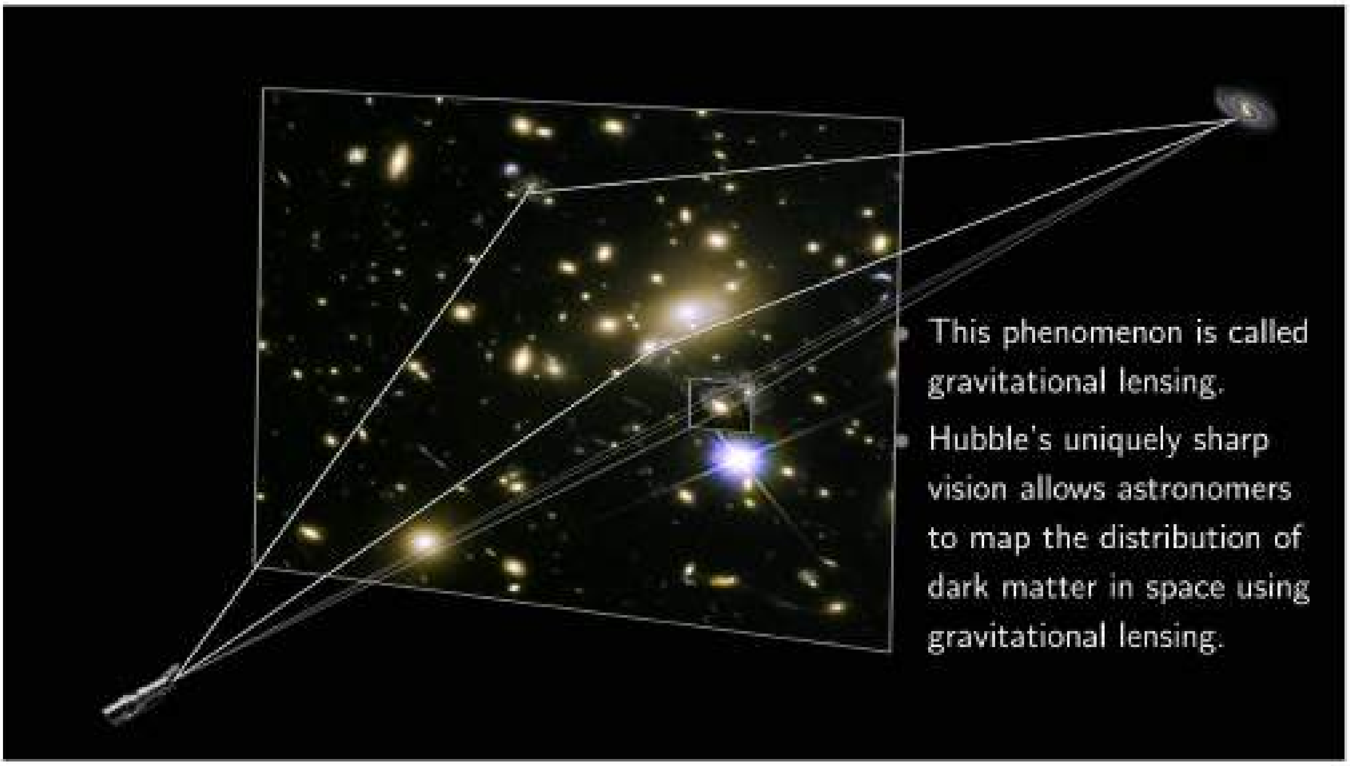
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The Physics of Musical Notes

Seminar organised by Dept. of Physics
in collaboration with IQAC, Mathabhanga College

Academic year:
2021-22

Date and time:
Mar 23, 2022 at 1:30 pm

Speaker:
Dr. Rashidul Islam
Assistant Professor
Department of Physics
Mathabhanga College

Introduction

Dr. Sulagna Dutta, the *Teacher-in-Charge* (TIC), Mathabhanga College, who is also a professor of the Department of Physics, inaugurated the session with a brief motivational speech to the students. Prof. Aparna Biswas, the IQAC Coordiantor, Mathabhanga College followed on with her own contribution to arouse the students' curiousity further.

Afterwards, Dr. Rashidul Islam delivered his lecture to the students to pique the curiosity of the students further high up. Prof. Neelam Roy of the Department of Physics chaired the session. Her timely inputs made the Question & Answer session a joyful experience for the undergrads of the department.

For the use of students and teachers alike, we attach the slides of Dr. Islam with this report.

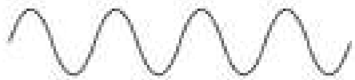
Back to basics : Characteristics of a musical note

- Music is the art of sound, so let's start by talking about sound. Sound is invisible waves moving through the air around us.
- In the same way that ocean waves are made of ocean water, sound waves are made of the air (or water or whatever) they are moving through.
- When something vibrates, it disturbs the air molecules around it. The disturbance moves through the air in waves spreading out from the thing that made the sound.

Noise

- Surf rolling down a beach, leaves rustling in the wind, a book thudding on a desk, or a plate crashing on the foor all make sounds, but these sounds are not music.

Tone



- A rhythmic, organized set of thuds and crashes is perfectly good music.

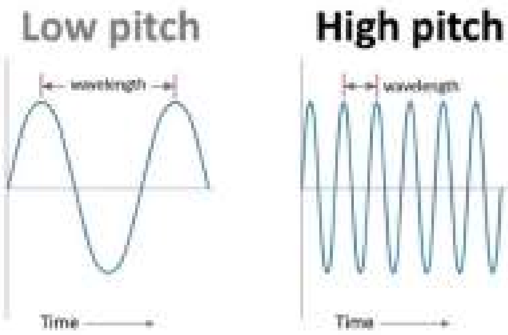
Characteristics of a musical note

- Many musical instruments are designed specifcally to produce the regular, evenly spaced waves that we hear as particular pitches (musical notes).
- Crashes, thuds, and bangs are loud, short jumbles of lots of different wavelengths. The sound of surf, rustling leaves, or bubbles in a fish tank are also white noise, the term that scientists and engineers use for sounds that are mixtures of all the different wavelengths (just as white light is made of all the different wavelengths, or colors, of light).

- A tone (the kind of sound you might call a musical note) is a specific kind of sound. The vibrations that cause it are very regular - all the same size and same distance apart.

Characteristics of a musical note

- Musicians have terms that they use to describe tones. But this kind of (very regular) wave is useful for things other than music, so scientists and engineers also have terms that describe tonal sound waves. It can be very useful to know both the scientific and the musical terms and how they are related to each other.

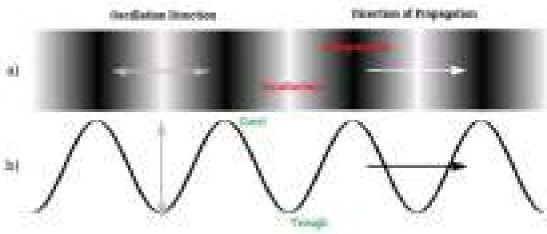


- Musicians talk about the pitch of the sound, or name specific notes, or talk about tuning. Scientists and engineers, on the other hand, talk about the frequency and the wavelength of the sound. They are all essentially talking about the same thing.

Transverse and Longitudinal Waves

- Waves are disturbances; they are changes in something - the surface of the ocean, the air, electromagnetic felds. Normally, these changes are travelling (except for Standing Waves); the disturbance is moving away from whatever created it

- Most kinds of waves are transverse waves.
- But sound waves are not transverse. Sound waves are longitudinal waves.

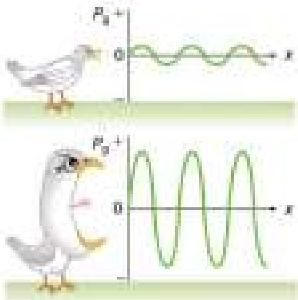


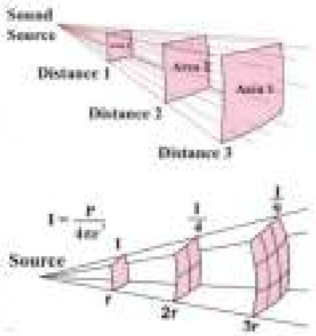
- Sounds which are periodic have a definite pitch. Sounds with a definite pitch are periodic. We showed this in the previous slide.

Loudness, Intensity, Decibels and Logarithms

$$\textbf{Intensity} = \frac{\text{Power}}{\text{Area}};$$

$$\textbf{Power} = \frac{\text{Energy}}{\text{time}}.$$





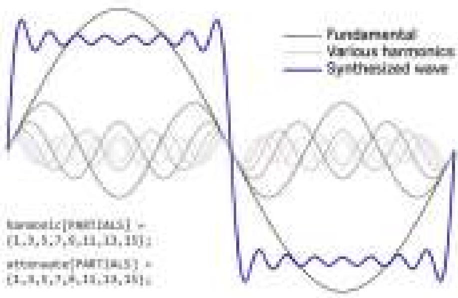
- Because the range of intensities which the ear can respond to is so large, it is most practical to describe it using logarithms.
- A deciBel (dB) is defined to be

$$\# \text{ of dB for a sound} = 10 \times \log_{10} \frac{\text{Intensity}}{10^{-12}\ \mathrm{W/m^2}}$$

The softest sound you can hear is $I = 10^{-12}\ \mathrm{W/m^2}$.

Aural Harmonics

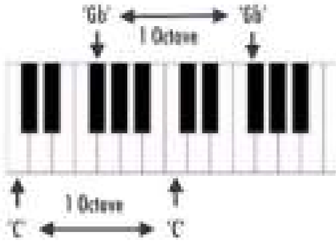
- Well, suppose the input sound is a sine wave. The output sound is distorted, typically by having the tops and bottoms trimmed, not necessarily by the same amount. That is no longer a sine wave. However, it is still a periodic wave.
- That means that harmonics get added to the wave, which were not present to begin with.
- The distortion is always the addition of harmonics with integer related frequencies (that is, play 300 Hertz, and the generated extra sine waves have frequencies of 600, 900, 1200, etc Hertz).



- These added harmonics are called **aural harmonics**, since they are harmonics added by the ear.

Intervals and Scales

- Most musical traditions use several fixed frequencies, which have been chosen to ensure the presence of pairs of notes with overlapping harmonics.
- If a frequency f is a standard note, that twice the frequency, $2 \times f$, also be a standard note (one **octave** up). Again, if f is a standard note, the note at 1.5 times that frequency (up by one **fifth**), also be a standard note.
- There is an amazing numerical coincidence:



$$2^{7/12} \simeq 1.5 = \frac{3}{2}$$

which means that if we divide the octave into 12 evenly spaced (in logarithm) frequency steps, then notes separated by 7 of those steps will be related by a musical fifth, the ratio 1.5. And this can be shown for other cases also.

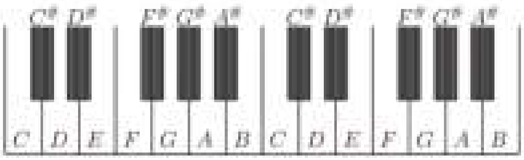
Musical scale

- Because of these numerical accidents, music designed around 12 (approximately) even divisions of the octave, that is, frequencies which are some standard times $1, 2^{1/12}, 2^{2/12}, 2^{3/12}, \cdots, 2^{12/12} = 2$, has been adapted on this idea: the Western musical tradition, the Eastern pentatonic tradition, and West African tradition (which uses $2^{1/24}$, half the spacing).
- How should these notes be used in music?
- It turns out that using all of them encounters numerous dissonances and consonances.
- Therefore it is a good idea to only use some of the 12 available notes, to make these overlaps rare.
- In Western tradition, this problem is solved by using the adjoining notes.

frequency	name
$f_0 \times 1$	Sa
$f_0 \times 2^{2/12} = 1.1225$	Re
$f_0 \times 2^{4/12} = 1.2599$	Ga
$f_0 \times 2^{5/12} = 1.3348$	Ma
$f_0 \times 2^{7/12} = 1.4983$	Pa
$f_0 \times 2^{9/12} = 1.6818$	Dha
$f_0 \times 2^{11/12} = 1.8877$	Ni
$f_0 \times 2$	sa

Musical scale

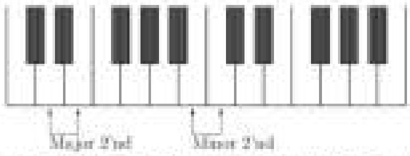
- Then tune the piano, and allow someone to start with "Sa" being either the standard value or anything separated by some number of half-steps from that standard value.
- The standard value for Sa is named C, and Re etc are named Re$= D$, Ga$= E$, Ma$= F$, Pa$= G$, Dha$= A$, and Ni$= B$. It has become conventional to tune A to 440 Hertz. In that case we name the notes as follows:
- On the piano keyboard, it looks like this:



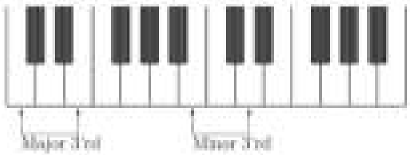
frequency	half-steps above Do	name
$f_0 \times 1$	0	C
$f_0 \times 2^{1/12}$	1	$C^\sharp = D^\flat$
$f_0 \times 2^{2/12}$	2	D
$f_0 \times 2^{3/12}$	3	$D^\sharp = E^\flat$
$f_0 \times 2^{4/12}$	4	E
$f_0 \times 2^{5/12}$	5	F
$f_0 \times 2^{6/12}$	6	$F^\sharp = G^\flat$
$f_0 \times 2^{7/12}$	7	G
$f_0 \times 2^{8/12}$	8	$G^\sharp = A^\flat$
$f_0 \times 2^{9/12}$	9	A
$f_0 \times 2^{10/12}$	10	$A^\sharp = B^\flat$
$f_0 \times 2^{11/12}$	11	B
$f_0 \times 2^{12/12}$	12	C

Intervals

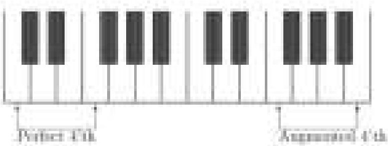
- The nomenclature for intervals is as follows: if two keys are next to each other, the interval is a **second**; if they are separated by 1 key, it is a **third**; by two keys, a **fourth**; and so forth.
- A separation of 2 half-steps is called a **major second** (also a **whole step**); a separation of one half-step is a **minor second** (also **half-step**).

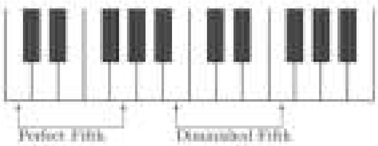


- For the thirds: a separation of 3 half-steps is called a **minor third**, and 4 half-steps is a **major third**.



- And so on...





- *So, next time you listen to a good music, rememeber that there is some physical concept behind each note that is being played.*


THANK YOU :)

$E=mc^2$ and the Disaster in Hiroshima and Nagasaki

Dr.SulagnaDutta
Department of Physics
Mathabhanga College, Coochbehar
West Bengal

Special Lecture in Mathabhanga College
(11th September, 2017)

$E=mc^2$ and the Disaster in Hiroshima and Nagasaki

Speaker: SulagnaDutta
Assistant Professor, Department of Physics, Mathabhanga College, CoochBehar, India
sulagnaphysics@gmail.com

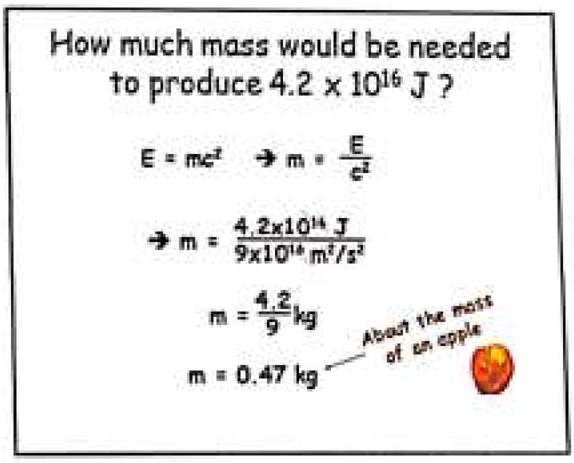
The programme was inaugurated by Prof. R.M. Roy, Teacher-in-charge of Mathabhanga College. On this occasion Prof. R.M, Roy and , Coordinator of IQAC, Mathabhanga College presented their thoughts and visions on the College in front of the students, teachers and non-teaching staffs. After inauguration, Dr. S. Dutta presented a very lucid and interactive presentation in front of the audience consists largely of the undergraduate physics students of the Physics department of Mathabhanga College. She enlightened on the topic "E=mc2 and the Disaster in Hiroshima and Nagasaki". The details of her lecture is attached with this report.

We had an intensive question-answer session where the speaker addressed the queries of the student. Overall the enthusiasms of the student made our effort successful and we hope that this type of special lectures would motivate the students to pursue higher studies in physics.

Detailed Lecture:

Albert Einstein's equation $E=mc^2$ for the first time connected the mass of an object with its energy. This is the most famous equation in the history of equations. It has been printed on countless t-shirts, posters and banners etc. It says that the energy in a system is equal to its total mass multiplied by the square of the speed of light in free space. Thus we can say that mass contains an enormous amount of energy.

Let us have an example, how much mass would be needed to produce 4.2×10^{16} Joule of energy.



Thus if we convert the 0.47 kg mass into energy, that energy would be sufficient to run 5 million homes for at least 3 years.

The ideas that led to the equation were set down by Einstein in 1905, in a paper submitted to the *Annalen der Physik* called "Does the Inertia of a Body Depend Upon Its Energy Content?". The relationship between energy and mass came out of another of Einstein's ideas, special relativity, which was a radical new way to relate the motions of objects in the universe.

At one level, the equation is devastatingly simple. It says that the energy (E) in a system (an atom, a person, the solar system) is equal to its total mass (m) multiplied by the square of the speed of light (c, equal to

,000 miles per second). Like all good equations, though, its simplicity is a rabbit-hole into something ofound about nature: energy and mass are not just mathematically related, they are different ways to easure the same thing. Before Einstein, scientists defined energy as the stuff that allows objects and fields o interact or move in some way – kinetic energy is associated with movement, thermal energy involves heating and electromagnetic fields contain energy that is transmitted as waves. All these types of energy can be transformed from one to another, but nothing can ever be created or destroyed.

In relativity theory, Einstein introduced mass as a new type of energy to the mix. Beforehand, the mass of something in kilograms was just a measure of how much stuff was present and how resistant it was to being moved around. In Einstein's new world, mass became a way to measure the total energy present in an object, even when it was not being heated, moved or irradiated or whatever else. Mass is just a super-concentrated form of energy and, moreover, these things can turn from one form to the other and back again. Nuclear power stations exploit this idea inside their reactors where subatomic particles, called neutrons, are fired at the nuclei of uranium atoms, which causes the uranium to split into smaller atoms. The process of fission releases energy and further neutrons that can go on to split more uranium atoms. If you made very precise measurements of all the particles before and after the process, you would find that the total mass of the latter was very slightly smaller than the former, a difference known as the "mass defect". That missing matter has been converted to energy and you can calculate how much using Einstein's equation.

Despite the tiny discrepancy in mass between the uranium atom and its products, the amount of energy released is big and the reason why is obvious when you look at the c^2 term in the equation – the speed of light is a huge number by itself and its square is therefore enormous. There is a lot of energy condensed into matter — 1kg of "stuff" contains around 9 x 10^16 joules, if you could somehow transform all of it into energy. That is the equivalent of more than 40 megatons of TNT. More practically, it is the amount of energy that would come out of a 1 gigawatt power plant, big enough to run 10 million homes for at least three years. A 100kg person, therefore, has enough energy locked up inside them to run that many homes for 300 years.

Unlocking that energy is no easy task, however. Nuclear fission is one of several ways to release a tiny bit of an atom's mass, but most of the stuff remains in the form of familiar protons, neutrons and electrons. One way to turn an entire block of material into pure energy would be to bring it together with antimatter. Particles of matter and antimatter are the same, except for an opposite electrical charge. Bring them together, though, and they will annihilate each other into pure energy. Unfortunately, given that we don't know any natural sources of antimatter, the only way to produce it is in particle accelerators and it would take 10 million years to produce a kilogram of it.

It would be nice to think that Einstein's equation became famous simply because of its fundamental importance in making us understand how different the world really is to how we perceived it a century ago. But its fame is mostly because of its association with one of the most devastating weapons produced by humans – the atomic bomb. At the start of World War II in 1939, the atomic bomb had not yet been invented. Einstein realised that powerful explosion might be possible by the fission reaction of Uranium. He was frightened about what might happen if Germany learned how to make bomb first. He wrote a letter to US President Franklin Roosevelt. As a result, Roosevelt set up the Manhattan Project. Einstein did not work directly on the atom bomb. But it was his equation which made the atom bomb theoretically possible and it was his initiative which started US bomb research.

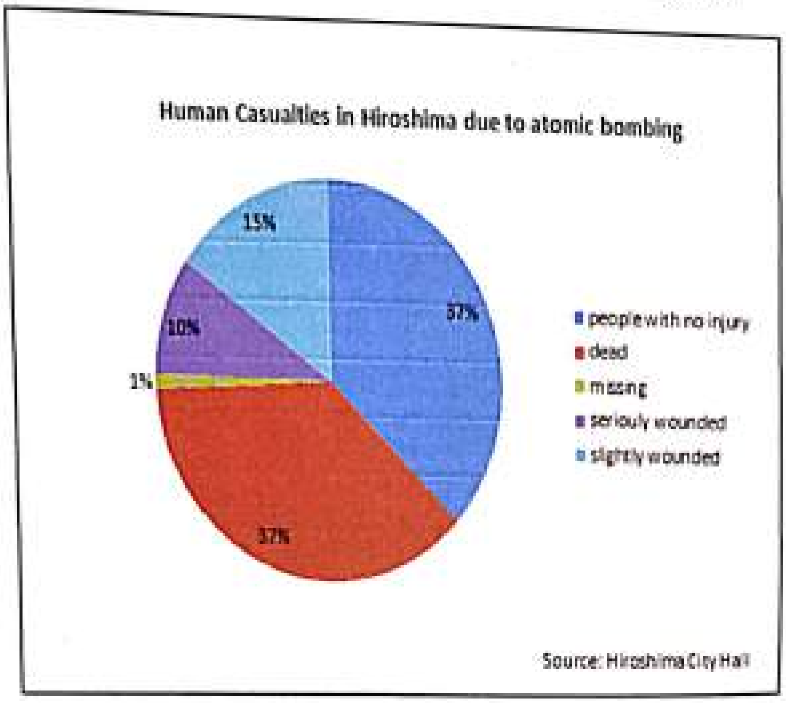
In 1942, the physicist Fermi successfully controlled the first nuclear reaction in his reactor. By the time, the first atomic bomb had been made, Germany had already surrendered and the World War II in Europe was over. Japan was defeated as well, but did not surrender. US was contemplating an invasion of Japan. President Truman decided to drop the atomic bomb. The atomic bomb named "Little Boy" was dropped on Hiroshima by the Enola Gay, a Boeing B-29 bomber, at 8:15 in the morning of August 6, 1945. Another atom bomb named "Fat Man" was dropped on Nagasaki 3 days later on August, 9, 1945. The following are the features of the atomic bombs:

Atomic Bombs

Little Boy	Fatman
Hiroshima	Nagasaki
Weight: 4 tons	Weight: 5 tons
Energy realised: Equivalent to 12.5 kilotons of TNT	Energy realised: Equivalent to 20 kilotons of TNT

'My God, what have we done?' This was the reaction of John Lewis, Co-pilot of the Engola Gay after dropping the bomb in Hiroshima. The centre of the explosion was hotter than the surface of the Sun. These are few heart-wrenching photographs of the affected people.

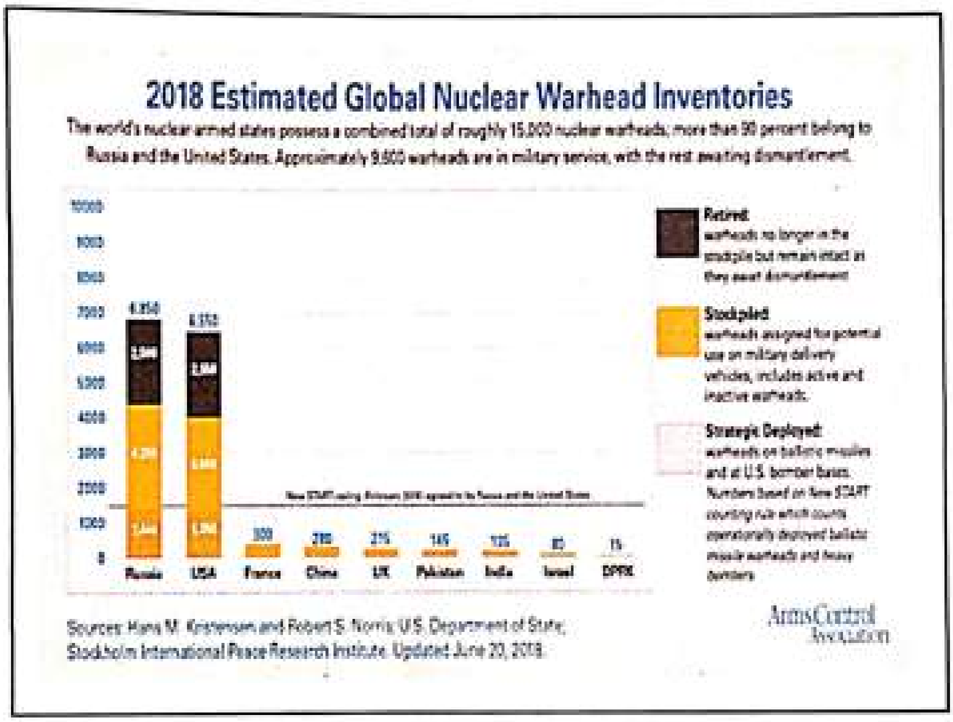
1,40,000 persons were killed in Hiroshima and 74,000 persons were killed in Nagasaki.



ades later, the radiation was still producing harmful after effects. Leukaemia and other cancers appeared er the decades and radiation effects still threaten the health of the survivors. There were thousands illborn. Thousands of war orphans were created by the bombing.

Two days after the bombing, Jacobsen, a Manhattan Project Physician, stated that nothing would grow in Hiroshima for 70 years. However just one month later, red Canna flowers began to sprout less than 1 km from the hypocentre. Then on 17th September, the Makurazki typhoon hit Hiroshima. This resulted flood which brought a layer of fresh, radiation free top soil which helped the city's flora to return. The following spring, the city's iconic Cherry trees were blooming. So initially the nature took the charge of disaster management. Humans destroyed Hiroshima and Nagasaki but humans also rebuilt it.

Now there is war like situation between India and Pakistan. The defence preparedness is costing India very high, but there is no escape so long as the war clouds are there in the horizons of the Himalayan boarder. The following graph shows the possession of nuclear weapons of different countries.



On 7th July, 2017, The UN adopted the Treaty on the prohibition of Nuclear Weapons. I believe that nuclear weapons are inhuman, immoral and illegal. All countries should join the Treaty on the Prohibition of Nuclear Weapons.Let us join our hands for the hope of nuclear weapon free future and don't let any scientific invention be a cause of such a devastating man-made disaster.

This is a human being?

Look how the atom bomb changed it.

Flesh swells fearfully.

All men and women take one shape.

The voice that trickles from swollen lips on the festering, charred-black face whispers the thin words,

"Please help me."

This, this is a human being.

This is the face of a human being.

"Flower of Summer" (Natsu no Hana), a collection of short stories by Tamiki Hara (1905-1951), writer and a -bomb survivor.

………………………………………………………………………

Bending of Light in a wrong way: Negative Refractive Index

Dr. SulagnaDutta
Department of Physics
Mathabhanga College, Coochbehar
West Bengal

Special Lecture in Mathabhanga College
(18th January, 2018)

Bending of Light in a wrong way: Negative Refractive Index

SulagnaDutta

Assistant Professor, Department of Physics, Mathabhanga College, CoochBehar, India
sulagnaphysics@gmail.com

The programme was inaugurated by Prof. R.M. Roy, Teacher-in-charge of Mathabhanga College. On this occasion Prof. R.M, Roy and , Coordinator of IQAC, Mathabhanga College presented their thoughts and visions on the College in front of the students, teachers and non-teaching staffs. After inauguration, Dr. S. Dutta presented a very lucid and interactive presentation in front of the audience consists largely of the undergraduate physics students of the Physics department of Mathabhanga College, She enlightened the students on the topic of the negative refractiveindex material, possessing negative real parts of both permittivity ε_r and magnetic permeability μ_r over a certain frequency band, was first introduced by Veselago in 1960s. The important feature belonging to Negative index material is the negative refraction denoted by real part of an index $n=-\sqrt{(\varepsilon_r\mu_r)}$.

We had an intensive question-answer session where the speaker addressed the queries of the student. Overall the enthusiasms of the student made our effort successful and we hope that this type of special lectures would motivate the students to pursue higher studies in physics.

MATHABHANGA COLLEGE, COOCHBEHAR

DEPARTMENT OF PHYSICS

Report on special lecture

On

By

Mr. Samser Doha Ahmed

Report on special lecture on

By

Mr. Samser Doha Ahmed

Academic Year:2019-2020

Date: 13/01/2020

Time:12pm to 2pm

Details of the faculty

Name: Samser Doha Ahmed

Designation: SACT

Institution: Mathabhanga College

Qualification: M.Sc

Specialization:

Contact Number: 7797018188

Email id: samserdoha20171@gmail.com

Introduction

The lecture session began with a speech by Dr. Sulagna Dutta,H.O.D.Dept of Physics ,Mathabhanga College.After that Mr. Samser Doha Ahmed started his lecture with an introduction to this topic and he explained the topic very briefly and very clearly.

OUTLINE OF LECTURE

Sequential Logic Design

- Introduction
- Registers
- Application of shift resisters
- Ripple or Asynchronous Counters
- Synchronous Sequential Circuits Design
- Asynchronous Sequential Circuits
- Hazards in sequential Circuit

Conclusion

After the completion of the lecture, there was an interactive session, where students asked their doubts. The special lecture was interesting and informative. The lecture concluded with a vote of thanks by the students and the other faculty members.

Attendance of the students

Attendance for Special Lecture

Academic Year 2019-2020

[illegible]

Sl. No.	Student's Name	Semester	Signature
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]

Mathabhanga College , Coochbehar

Department of physics

Report on special lecture

On

Radioactivity

By

Mr Eya Hannan

12/02/2020 , 12pm to 2pm

Report on special lecture on

Radioactivity

By

Mr Eya Hannan

Academic year: 2019-2020

Date: 12/02/2020

Time: 12pm to 2pm

Details of the faculty

Name: Eya Hannan

Designation: SACT

Institution: Mathabhanga College

Qualification: M.Sc

Specialization: Nuclear Physics

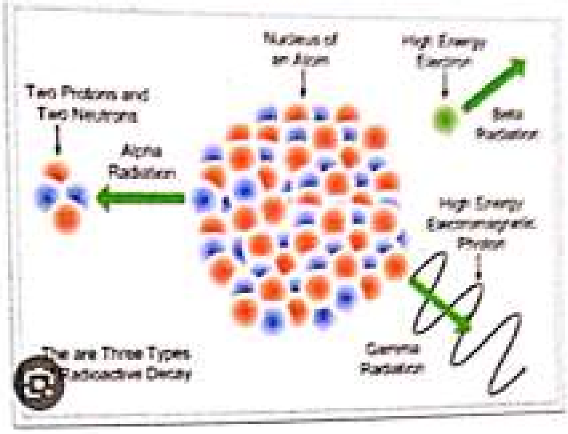
Contact Number: 9064355815

Email Id: eyahannan04@gmail.com

Introduction

The lecture session began with a speech by Dr Sulagna Dutta , H.O.D. , Physics Dept, Mathabhanga College. After that Mr Eya Hannan started his lecture with an introduction to this topic and he explained the topic very briefly and very clearly.

Outline of the Lecture



Radioactive decay (also known as nuclear decay, radioactivity, radioactive disintegration, or nuclear disintegration) is the process by which an unstable atomic nucleus loses energy by radiation. A material containing unstable nuclei is considered radioactive. Three of the most common types of decay are alpha, beta, and gamma decay, all of which involve emitting particles. The weak force is the mechanism that is responsible for beta decay, while the other two are governed by the electromagnetism and nuclear force.

Radioactive decay is a stochastic (i.e. random) process at the level of single atoms. According to quantum theory, it is impossible to predict when a particular atom will decay, regardless of how long the atom has existed.However, for a significant number of identical atoms, the overall decay rate can be expressed as a decay constant or as half-life. The half-lives of radioactive atoms have a huge range; from nearly instantaneous to far longer than the age of the universe.

Conclusion

After the completion of the lecture, there was an interactive session, where students asked their doubts. The special lecture was interesting and informative. The lecture concluded with a vote of thanks by the students and the other faculty members.

[redacted]

Attendance for Special Lecture
Academic Year - 2019-2020.

Date - 12/02/2020 Time 12PM-2PM

Sl. No.	Student's Name	Semester	Signature
1.	Jhumur Barman.	2nd	Jumur Barman
2.	Jasim uddin Ali.	2nd	Jasim uddin Ali
3.	Pradyut paul	2nd	[illegible]
4.	Mrinal Barman.	2nd	Mrinal Barman
5.	Suprita paul.	2nd	Suprita Paul
6.	Kalyan Barman.	2nd	Kalyan Barman
7.	Adrija Roy.	2nd	Adrija Roy
8.	Jahangir Alom.	2nd	Jahangir Alom
9.	Madan Gopal Roy.	2nd	Madan Gopal Roy
10.	Mamirul Hoque.	2nd	[illegible]
11.	Mainak Roy.	2nd	Mainak Roy
12.	Rita Sarkar.	2nd	Rita Sarkar
13.	Subha Bhadra	2nd	[illegible] Bhadra
14.	Mijanur Rahaman	6th	Mijanur Rahaman
15.	Nandita Roy.	6th	Nandita Roy
16.	Tanberul Alom.	6th	Tanberul alam
17.	Abhijit DAS	6th	[illegible]
18.	Samir Das.	6th	Samir Das
19.	Surasi Tarafdar.	6th	Surasi Tarafdar
20.	Payel Roy	4th	Payel Roy

Mathabhanga College, Coochbehar

Department of Physics

Report on special lecture

on

Optical Fibers

By

Mr Anirban Sarkar

18/2/2020, 12 PM to 2PM

Report on special lecture on

Optical Fibers

By

Mr Anirban Sarkar

Academic Year: 2019-2020

Date: 18/2/2020

Time: 12 PM to 2PM

Details of the faculty

Name: Anirban Sarkar

Designation: SACT

Institution: Mathabhanga College

Qualification: M.SC

Specialization: Condensed Matter Physics

Contact number: 9800577576

Email id: anirbansarkar145@gmail.com

Introduction

The lecture session began with a speech by Dr Sulagna Dutta , H.O.D. , Physics Dept, Mathabhanga College. After that Mr Anirban Sarkar started his lecture with an introduction to this topic and he explained the topic very briefly and very clearly.

Outline of Lecture

Optical fiber, refers to the technology that transmits information as light pulses along a glass or plastic fiber. A fiber optic cable can contain a varying number of these glass fibers -- from a few up to a couple hundred. Another glass layer, called cladding, surrounds the glass fiber core.

Optical fiber is used as a medium for telecommunication and computer networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because infrared light propagates through the fiber with much lower attenuation compared to electricity in electrical cables. This allows long distances to be spanned with few repeaters.

Optical fibers are used as light guides in medical and other applications where bright light needs to be shone on a target without a clear line-of-sight path. Many microscopes use fiber-optic light sources to provide intense illumination of samples being studied.

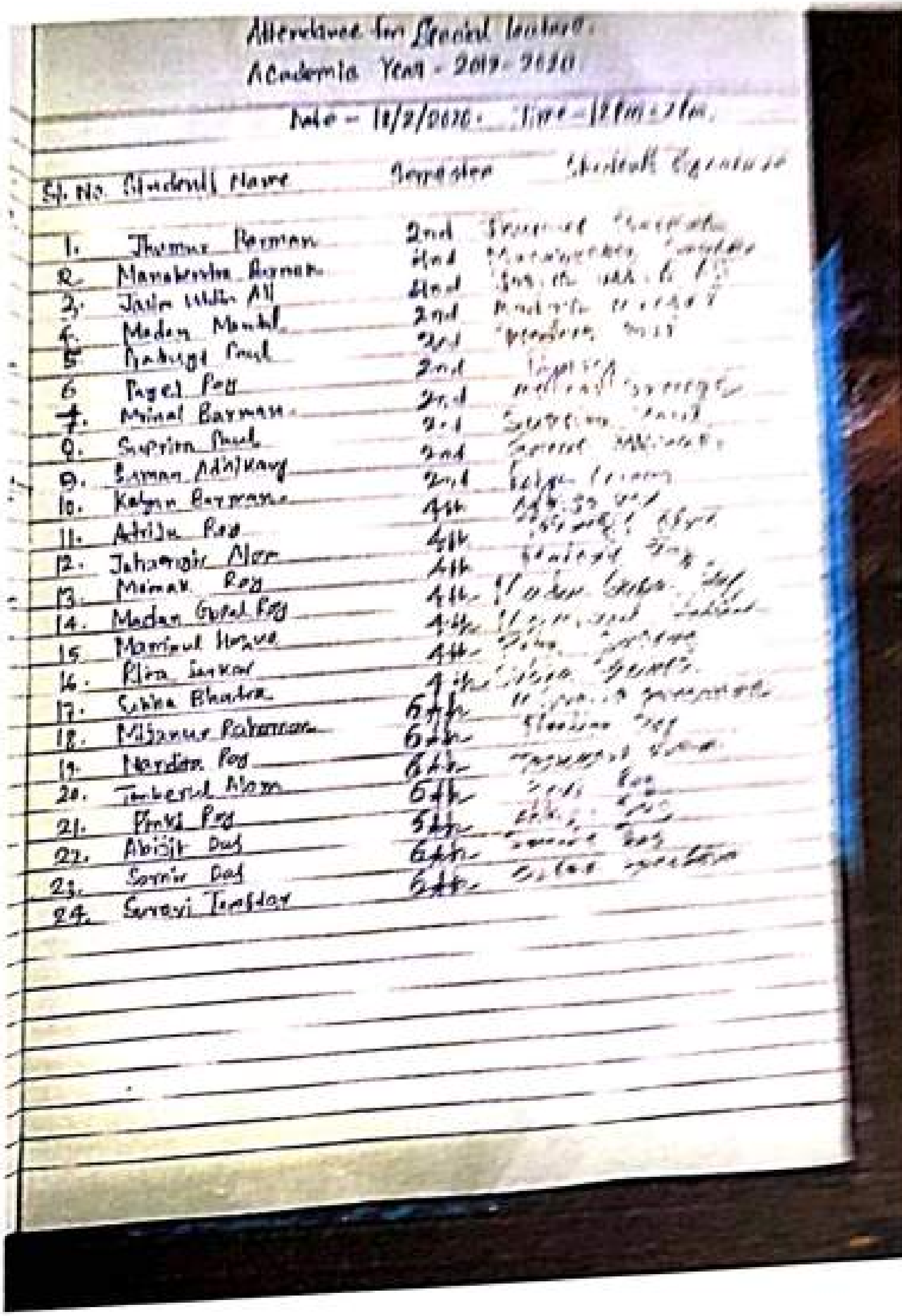
Optical fibers have many uses in remote sensing. In some applications, the fiber itself is the sensor (the fibers channel optical light to a processing device that analyzes changes in the light's characteristics). In other cases, fiber is used to connect a sensor to a measurement system.

Figure: A bundle of optical fibers.

Conclusion

After the completion of the lecture, there was an interactive session, where students asked their doubts. The special lecture was interesting and informative. The lecture concluded with a vote of thanks by the students and the other faculty members.

Attendance of the students :



Attendance for Special lecture.
Academic Year - 2019-2020.
Date - 18/2/2020. Time - 12PM - 2PM.

Sl. No.	Student's Name	Semester	Student's Signature
1.	Jhumur Barman	2nd	[illegible]
2.	Manabendra Barman	2nd	[illegible]
3.	Jasim Uddin Ali	2nd	[illegible]
4.	Madan Mondal	2nd	[illegible]
5.	Ranjan Paul	2nd	[illegible]
6	Pagel Roy	2nd	[illegible]
7.	Mrinal Barman	2nd	[illegible]
8.	Supriya Paul	2nd	[illegible]
9.	Raman Adhikary	2nd	[illegible]
10.	Kalyan Barman	4th	[illegible]
11.	Atrija Roy	4th	[illegible]
12.	Jahangir Alam	4th	[illegible]
13.	Mrinal Roy	4th	[illegible]
14.	Madan Gopal Roy	4th	[illegible]
15.	Maniul Haque	4th	[illegible]
16.	Rina Sarkar	4th	[illegible]
17.	Sikha Bhadra	6th	[illegible]
18.	Mijanur Rahaman	6th	[illegible]
19.	Nandan Roy	6th	[illegible]
20.	Tanbirul Alam	6th	[illegible]
21.	Pinki Roy	6th	[illegible]
22.	Abijit Das	6th	[illegible]
23.	Samir Das	6th	[illegible]
24.	Suravi Tarafdar		

Mathabhanga College, Coochbehar

Department of Physics

Report on special lecture

on

High Temperature Superconductivity

By

Mr Anirban Sarkar

13/3/2019, 12 PM to 2PM

Report on special lecture on

High Temperature Superconductivity

By

Mr Anirban Sarkar

Academic Year: 2018-2019

Date: 13/3/2019

Time: 12 PM to 2PM

Details of the faculty

Name: Anirban Sarkar

Designation: SACT

Institution: Mathabhanga College

Qualification: M.SC

Specialization: Condensed Matter Physics

Contact number: 9800577576

Email id: anirbansarkar145@gmail.com

Introduction

The lecture session began with a speech by Dr Sulagna Dutta , H.O.D. , Physics Dept, Mathabhanga College. After that Mr Anirban Sarkar started his lecture with an introduction to this topic and he explained the topic very briefly and very clearly.

Outline of Lecture

High-temperature superconductors are defined as materials that behave as superconductors at temperatures above 77 K (−196.2 °C; −321.1 °F), the boiling point of liquid nitrogen. The adjective "high temperature" is only in respect to previously known superconductors, which function at even colder temperatures close to absolute zero. In absolute terms, these "high temperatures" are still far below ambient, and therefore require cooling. The first high-temperature superconductor was discovered in 1986, by IBM researchers Bendroz and Müller.

The high-Tc superconductors have been used in many kinds of microwave devices such as resonators, filters, delay lines, couplers, antennas, waveguides, transmission lines, detectors, mixers, switches, oscillators, digital interconnects, wires, etc.

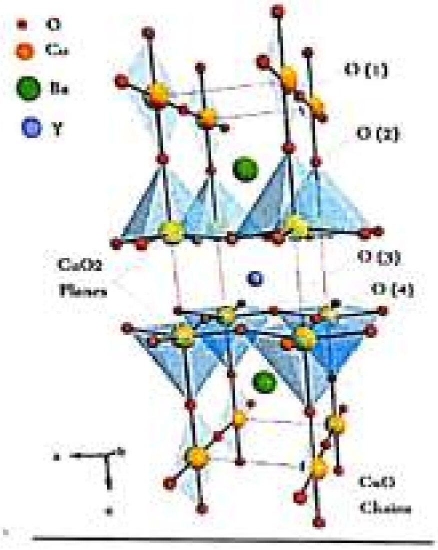


Figure: Unit cell for the Cuprate of Barium and Yttrium (YBCO), a high temperature superconductor.

Conclusion

After the completion of the lecture, there was an interactive session, where students asked their doubts. The special lecture was interesting and informative. The lecture concluded with a vote of thanks by the students and the other faculty members.

Attendance of the students:

Attendance for Special Lecture.
Academic Year - 2018 - 2019

Date – 13/3/2019 Time - 12Pm - 2Pm.

Student Name	Semester	Student's signature
Adria Roy	2nd	Adrija Roy
Shukha Bhadra	2nd	Sukha Bhadra
Jahangir Alam	2nd	Jahangir Alam
Rita Sarkar	2nd	Rita Sarkar
Sujan Barman	2nd	Sujan Barman
Subhadip Paul	2nd	Subhadip Paul
Sarani Tarafdar	4th	Sarani Tarafdar
Abhijit Das	4th.	Abhijit Das
Samir Das	4th	Samir Das
Pinki Roy	4th	Pinki Roy
Nandita Roy	4th	Nandita Roy
Biju Ghosh	4th	Biju Ghosh
Saumyajit Negi	4th	Saumyajit – Negi
Shubhamoy Dev	4th	Shubhamoy Dev
Farhad Hossain	3rd yr.	Farhad Hossain
Nirupam Barman	3rd yr.	Nirupam Barman
Tanmay Chakraborty	3rd yr	Tanmay Chakraborty
Rakesh Sharma	3rd yr.	Rakesh Sharma
Mainak Barman	3rd yr.	Mainak Barman